Defense Advanced Research Projects Agency

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DARPA Organization

Director, Tony Tether
Deputy Director, Vacant

Information Exploitation
Steven Welby(actg)
Robert Tenney

- **Sensors**
- **Exploitation Systems**
- **Command & Control**
- **Planning / Logistics**

Tactical Technology
Art Morrish
Gary Graham

- **Air/Space/Land Platforms**
- **Unmanned Systems**
- **Space Operations**
- **Laser Systems**
- **Future Combat Systems**

Special Projects
Amy Alving
Joe Guerci

- **Chem/Bio Def Systems**
- **Counter Underground Facilities**
- **Space Sensors/Structures**
- **Navigation/Sensors/ Signal Processing**

Advanced Technology
David Honey
Larry Stotts

- **Assured C3ISR**
- **Maritime**
- **Early Entry/Special Forces**

Information Awareness
John Poindexter
Robert Popp

- **Asymmetric Threat**
- **Prediction**
- **Behavior Modeling**

Defense Sciences
Michael Goldblatt
Steven Wax

- **Bio Warfare Defense**
- **Biology**
- **Materials & Devices**
- **Mathematics**

Infor Processing Technology
Ron Brachman
Zachary Lemnios

- **Cognitive Systems**
- **Architectures & Designs**
- **Processing & Storage**
- **Networks**
- **Human Computing Interfaces**

MicrosystemsTechnology
Robert Leheny
John Zolper

- **Electronics**
- **Optoelectronics**
- **MEMS**
- **Combined Microsystems**

Future Capabilities

Investments Today for Future Capabilities

- Bio Revolution
- Characterization of Underground Structures
- Precision Detection, Tracking, and Destruction of Elusive Surface Targets
- Networked Manned & Unmanned Systems
- Detect & Defeat Terrorist Networks
- Assured Use of Space
- Cognitive Systems

SOCOM vs DARPA Thrust Areas

• Signature Reduction	Cognitive Systems/SP
• Unmanned Systems	NW Man & Unman
• Remote Sensing	Detect, Track, Destroy
• Underwater Comms	Nw Man & Unman
• High BW Comm	Nw Man & Unman
• Batteries/Fuel Cells	Bio Revolution
• Advanced Training	Bio Revolution
• Bioengineering	Bio Revolution
• Directed Energy	Space/Special Projects
• Psychological Ops	Nw Man & Unman/Terror

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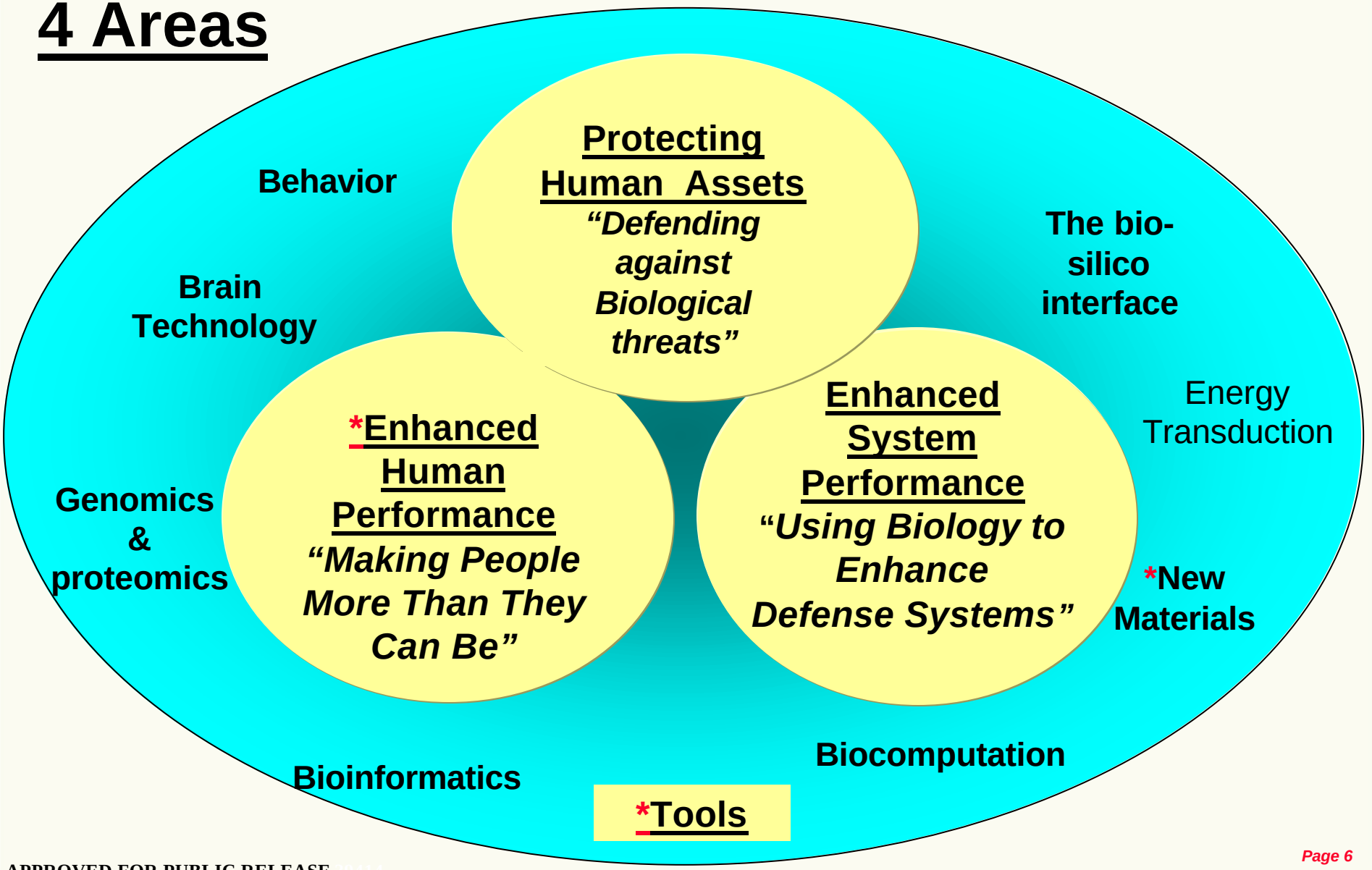
Bio Revolution

4 Areas



Water Purification Pen & Pump

Air Purification

- *Disinfection Pen*
  - 1/2, 1, 2, & 4 liter treatment volumes
  - Small and compact - 6”long
  - Uses common salt and camera batteries - 300 liters/set
  - Fault indicators
- Water from Air
- Water from Fuel Combustion
- Water from Urine
- Air purification

EXOSKELETON: Power Manwinch

Potential Applications for single-person lifting device

- High rescue; mountain, industrial, fire/emergency personnel, mining, etc.
- Recreational; spelunking, mountain climbing
- Forest research, tree canopy ascensions, etc.
- Arborist, tree trimmers, logging
- Industrial maintenance; tanks, vessel entry, stacks and chimneys
- Shipbuilding and related industries

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Characterization of Underground Facilities*

Function?

Operational Cycle?

Physical Features/ Vulnerability?

Battle Damage?

Technologies

- Passive Seismic, Acoustic, Electromagnetic (PASEM)
- Effluent Exploitation for "Vent Hunting"

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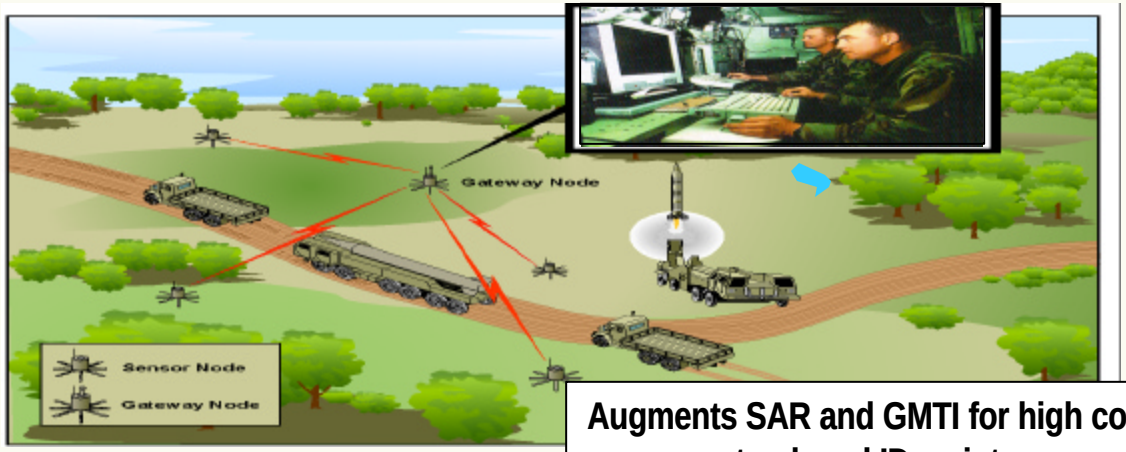
Emerging Sensor Web Technology

Concealed target track

Sensor to shooter delays ~ 0

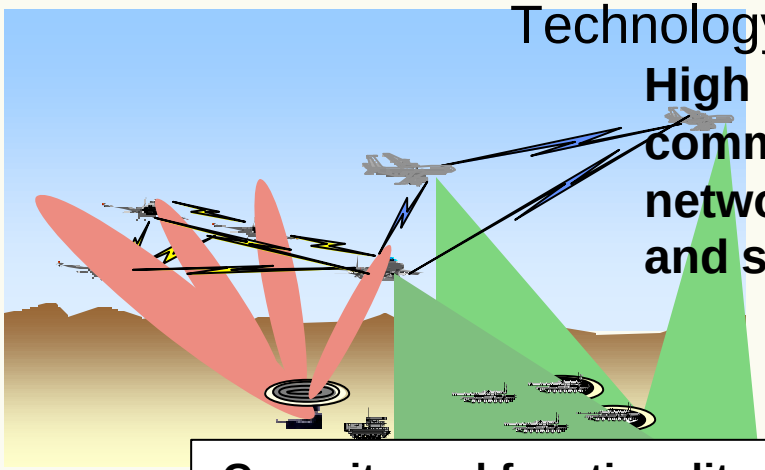
Tactical Sensors – Unattended Ground Sensors



Augments SAR and GMTI for high confidence track and ID maintenance

Tactical Targeting Network Technology (TTNT)

High capacity ad hoc communications networking of sensors and shooters

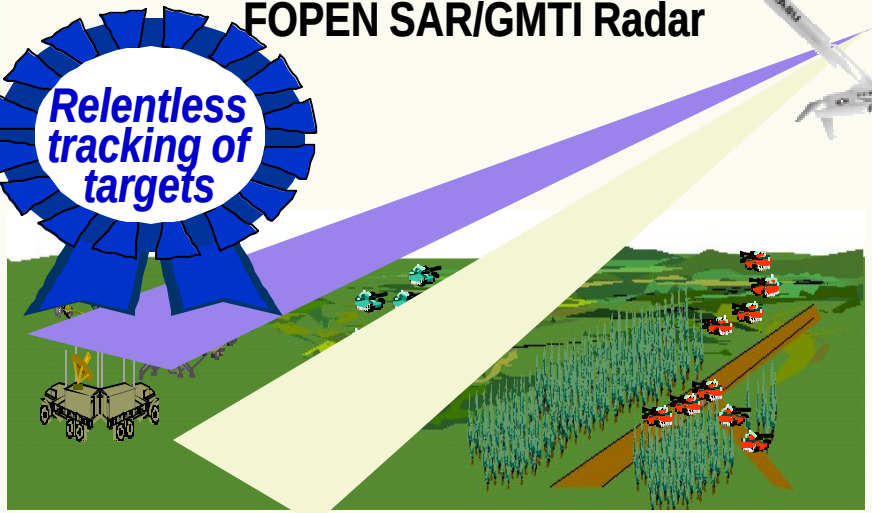


Capacity and functionality >JTIDS/Link 16

Emerging Sensor Technology

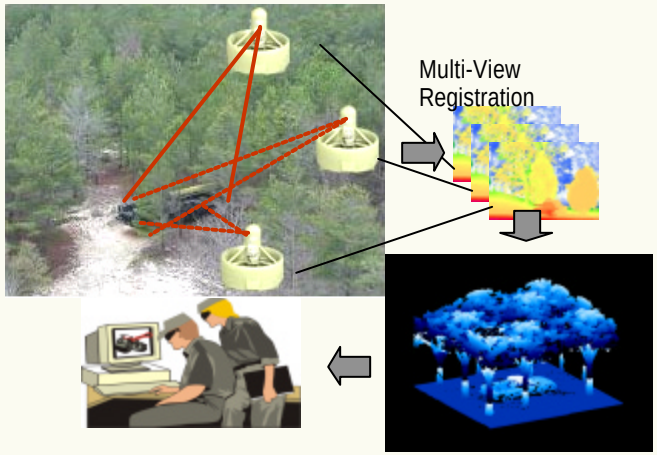
FOPEN SAR/GMTI Radar

Relentless tracking of targets



UHF radar tracks moving targets when line of sight is obscured by foliage; penetrates camouflage for SAR imaging

Jigsaw: 3-D Ladar Imaging and Exploitation for hard-to-ID targets



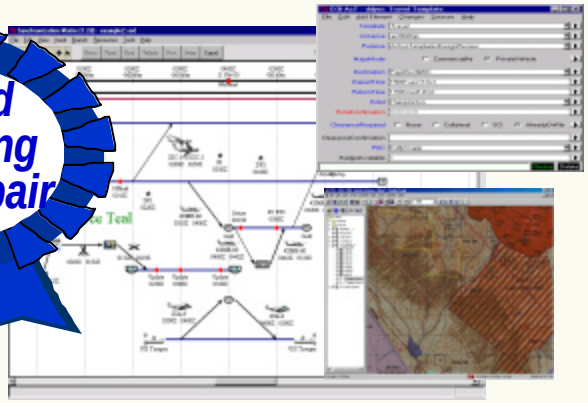
High confidence target ID

Penetrates gaps in foliage to generate ultra high resolution 3 D target signatures

Emerging Planning Technology

Active Templates

Rapid planning and repair



Dynamic spreadsheets for planning and control

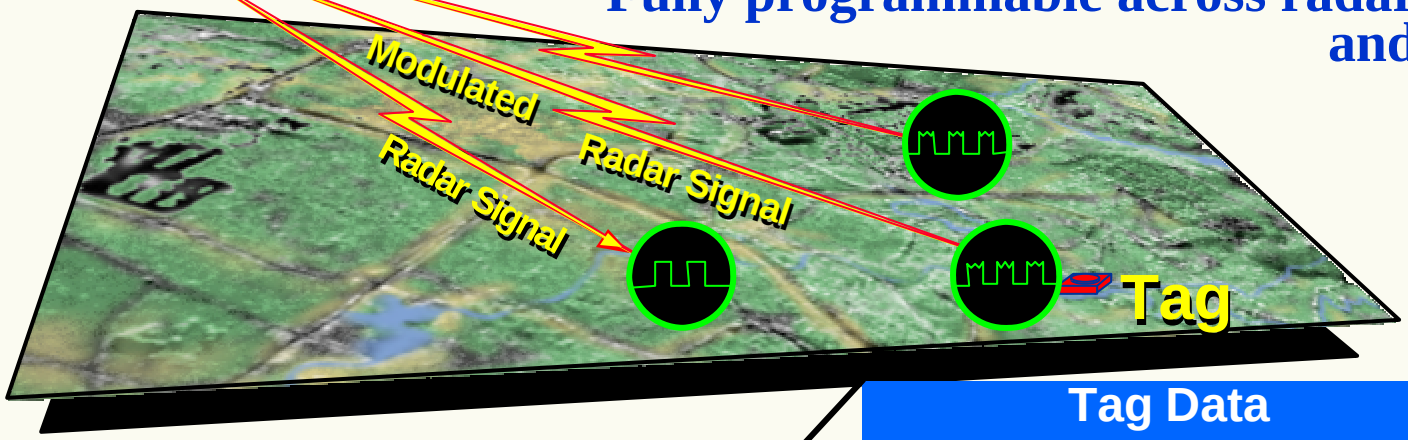
Operational at JSOC*

Plan elements captured as instructions not bytes

DRaFT Concept

Active Radar Responsive Tags

- Transforms radar into long-haul data link
- Direct combat ID and High Bandwidth Data Exfiltration
- Fully programmable across radars, modes, and missions



SAR Image

Tag Data

```
ID:      00174
TIME:    0438Z
LAT:     351439N
LONG:    1162614W
SENSOR:  E8C0012
MODE:    E8SAR
STATUS:  FF08A57C
TARGET:  01
RTIME:   0317Z
SIG:     002838FC3835985A5310
         769E090387AA32B13856
```

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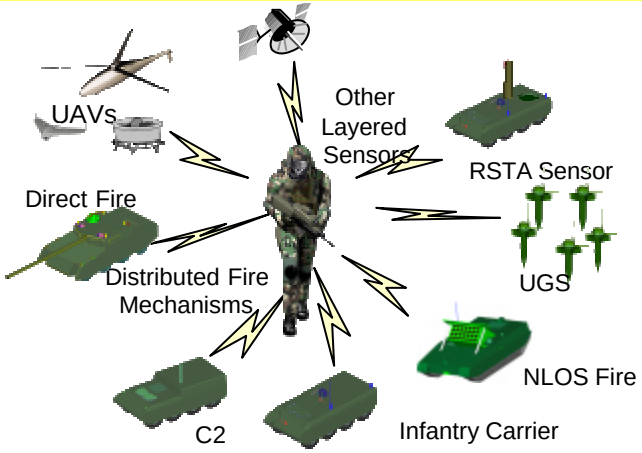
Unmanned Systems

Unmanned Combat Air Vehicle

Unmanned Combat Armed Rotorcraft

Stealthy Armed Capabilities

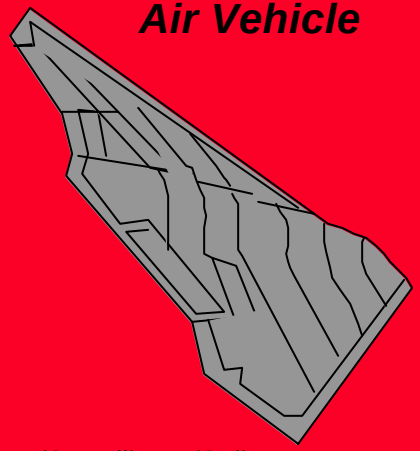
Canard Rotor Wing*



Micro Air Vehicle

Reconnaissance and Surveillance in Support of Unit of Action

Naval Unmanned Combat Air Vehicle

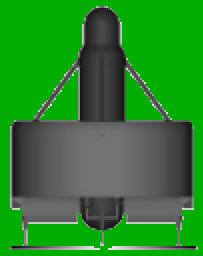


SEAD/Surveillance/Strike

A-160 Hummingbird*

RSTA and
Utility
Capability

Organic Air Vehicle



Target Acquisition in Support of FCS

Small Unit Operations Situational Awareness System

Objective Capabilities:

Highly Adaptive Radio

- Frequency Agility (20 MHz – 2,500 MHz)
- Data Rate (10 bps to 4 Mbps)
- Anti Jam, Low Probability of Detection

Mobile, Ad Hoc, Peer-to-Peer Networking

- Self Forming Mobile Networking
- Scaleable to 2500 Nodes and 7500 Sensors

Precision Navigation

- 1m Accuracy With GPS in Open Terrain
- 2m Accuracy Inside Buildings, Urban Canyons Etc. With Radio Ranging and Auxiliary Sensors

Distributed Information Management

- Situation Report/Data Aggregation and Reduction
- Relative Situational Awareness Data Disseminated by Organization, Tasks, Position and Threat Status

Software Programmable Radio with Integrated Features to Support Small Unit Operations

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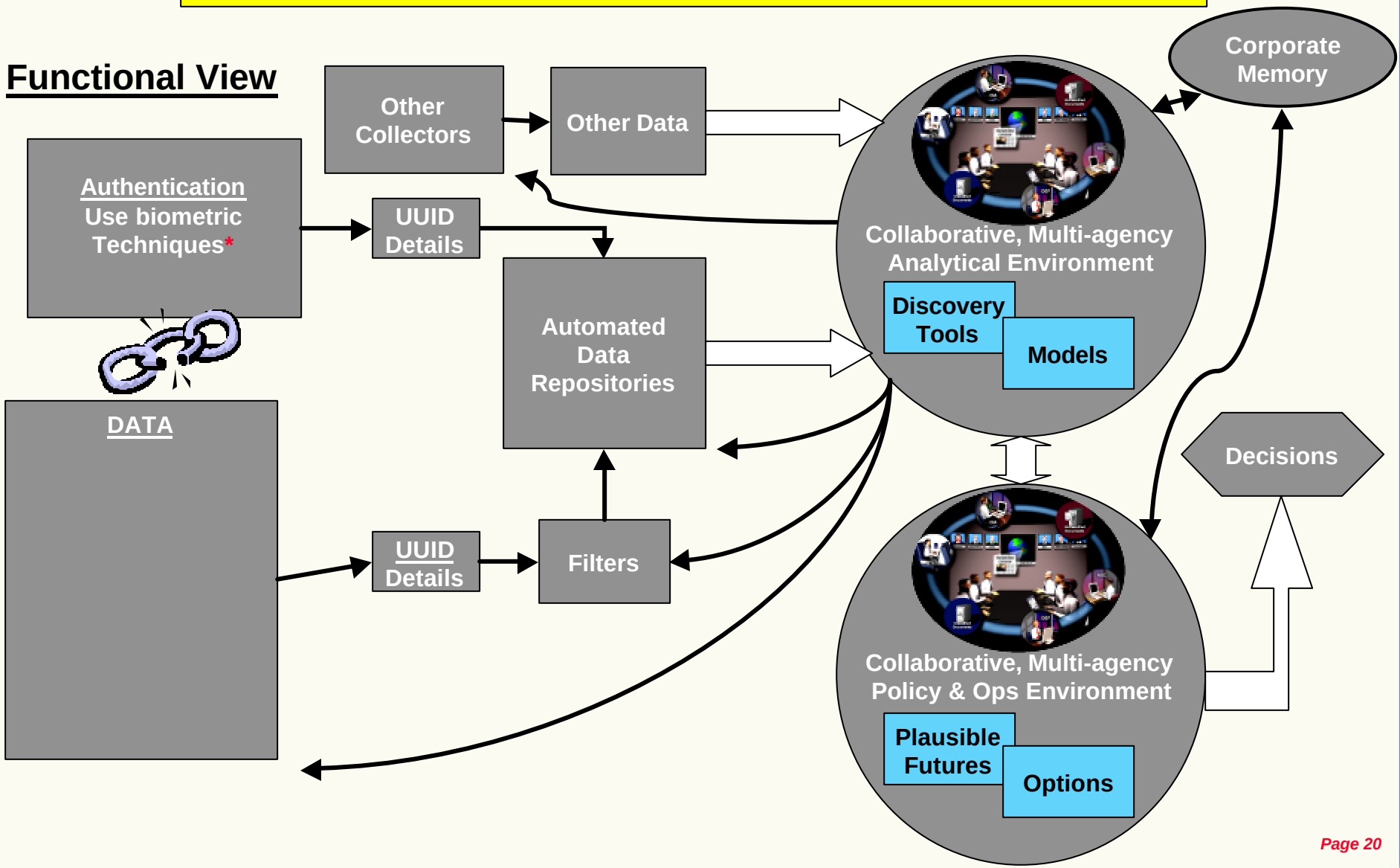
Total Information Awareness

Detect Æ Classify Æ ID Æ Track Æ Understand Æ Preempt

Functional View



Babylon Program

Goal: Develop rapid, two-way, natural language speech translation interfaces and platforms for users in combat and other field environments.

Voice Input	Audio Output
Halt! Don't move!	*Waisa, harkat nakon*!
Man komk mekham!	*I need help!*
Are you hurt?	*Aya majroh shodee?*
Man darde zayman daram!	*I am in labor!*
I'll call the medic	*Man grouhe imdadee ra khabar medaham*

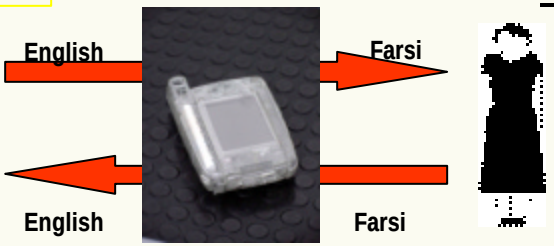
Multilingual Translation with an Interlingua

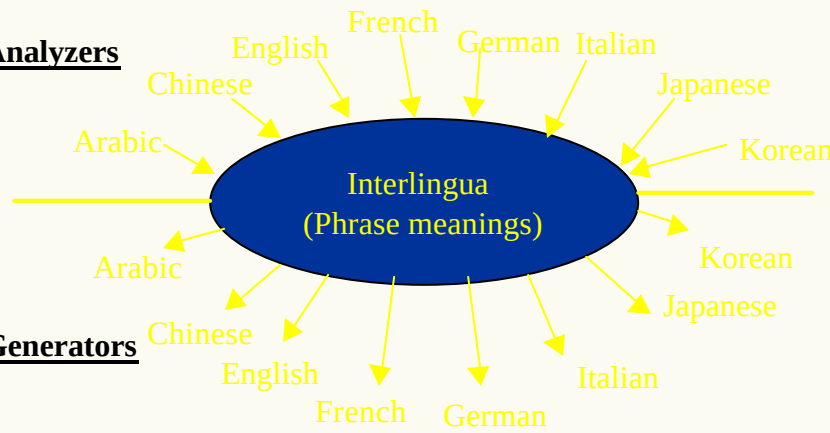
Impact:

- Significantly improve accuracy and speed of comprehension/translation of spoken foreign language communications thereby increasing situational awareness for the warfighter

Challenges:

- Translation accuracy
- Response time
- CPU footprints
- Production
- Logistics and training
- Exit strategy





Interlingua: Knowledge-based translation concept applies meaning to spoken phrases and outputs a close paraphrase in target language.

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Cognitive Systems

Systems That Know What They're Doing can…

- …assist in their own debugging
- …reconfigure themselves in response to environmental changes
- …respond to naturally-expressed directives to change behavior or increase functionality
- …be configured and maintained by non-experts
- …thwart adversarial systems that don't know what they're doing
- …last much longer than current systems

Distributed Robotics

Program Motivation – Small, light weight, mobile sensor platforms able to:

Infiltrate areas that humans or larger robots are unable to go (pipes & windows, up steps & walls) and to perform covert, dangerous, & distributed tasks.

Military Impact – Mobile sensor platforms

Carried, deployed, and operated by individual operators.

Distributed for large area coverage, networked connectivity (IPTO).

- **Urban warfare**
  - **Surveillance & Reconnaissance**
  - **Target verification/designation**
  - **BDA**
- Forward Operations
  - Airfield seizure
  - Ship to objective maneuver
- Ship-in-port protection
  - Land/water perimeter patrol
  - Ship hull inspection